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The Complex of Parasitic Hymenoptera (*Hymenoptera*: *Parasitica*) Occurring in Aphids Colonies on Decorative Shrubs in the Urban Environment

Zespół pasożytniczych błonkówek (*Hymenoptera*: *Parasitica*) występujących w koloniach mszyc na krzewach ozdobnych w środowisku miejskim

Abstract: Observations were carried out in the years 1999–2001 on the shrubs *Rosa* sp., *Juniperus communis* L., *Juniperus* x *pfitzeriana* (L. Späth) P.A. Schmidt, *Crataegus* x *media* Bechst., *Cotoneaster divaricatus* Rehder et E.H. Wilson, *Pinus mugo* Turra, *Cornus alba* L., *Spiraea japonica* L.f. in the urban conditions of Lublin. The purpose of the studies was to establish the species composition and the number of parasitic Hymenoptera accompanying the aphids. The obtained adult specimens of *Hymenoptera* were included into parasitoids of grades I (48%) and II (52%). Parasitic Hymenoptera of grade I belonged only to the family of *Aphidiidae. Trioxys angelicae* Haliday was the most numerous among them. Hyperparasitoids were included into five families (*Cynipidae*, *Pteromalidae*, *Encyrtidae*, *Eulophidae* and *Megaspilidae*) and the dominating species were *Charips victrix* Westwood and *Pachyneuron aphidis* Bouché. Parasitization of aphids on the examined shrubs was small and it ranged from 0.08% to 4.35%.

Key words: aphids, parasitoids, *hiperparasitoids*, ornamental shrubs

INTRODUCTION

A lot of deciduous and coniferous species of decorative shrubs, which are precious ornamental elements, are planted in the urban green areas. They constitute a nutritious base for a number of the phytophagous species from different systematic groups. The urban environment creates favourable conditions mainly for the development of arthropods with a stinging-sucking mouth apparatus, which include aphids. They are characterised by considerable species variability and high reproductive potential. Parasitic Hymenoptera, which are included into two families, namely *Aphidiidae* and *Aphelinidae*, play an important role in

limiting the aphid population. Their numbers and hence their effectiveness is related to the biotic and abiotic factors (Haley and Hogue, 1990). The most important of them comprise temperature (Sigsgaard, 2000), humidity (Weisser *et al*., 1997) and the availability of the nutritious base of a given habitat.

The purpose of the present studies was to determine the species composition and the number of parasitic Hymenoptera (*Hymenoptera*: *Parasitica*) occurring in aphid colonies inhabiting the decorative shrubs in the urban agglomeration of Lublin.

MATERIAL AND METHODS

The studies were carried out in the years 1999–2001 on decorative shrubs growing in the urban green areas of Lublin in two sites: a street (A) and a park (B) ones. The observations comprised eight plant species: *Rosa* sp., *Juniperus communis* L., *Juniperus* x *pfitzeriana* (L. Späth) P.A. Schmidt, *Crataegus* x *media* Bechst., *Cotoneaster divaricatus* Rehder et E.H. Wilson, *Pinus mugo* Turra, *Cornus alba* L., *Spiraea japonica* L.f. Five shrubs of a given species growing close to each other were selected in each site. Five shoots were randomly chosen on each shrub, where aphids and mummies were counted. The plants were monitored with about 10-days' intervals, from early spring till late autumn. The mummified aphids were taken for rear. They were placed together with small fragments of leaves or shoots in testing tubes that were choked up with a cotton wool cork slightly dripped with water. The rear was continued until the parasitic Hymenoptera flew away.

RESULTS

During the three years of studies the presence of parasitized aphids was found only on five shrub species *Rosa* sp., *Juniperus communis* L., *Crataegus* x *media* Bechst., *Cotoneaster divaricatus* Rehder et E.H. Wilson and *Pinus mugo* Turra. Totally from all these srubs, 793 parasitized aphids were collected in site A and 491 in site B. Then, 250 and 164 specimens of parasitic Hymenoptera respectively were reared. The most numerously parasitized aphids were observed on the shrubs of *P. mugo*.

The imagines of *Hymenoptera* belonged to parasitoids of both grades I and II. The parasitic Hymenoptera of grade I included 198 specimens, which constituted 48% of all the obtained parasitoids. They belonged exclusively to the family *Aphidiidae.* Among them 7 species were marked, which belonged to 3 sub-families: *Aphidiinae*, *Ephedrinae* and *Prainae* (Tab. 1). The most numerous species was *Trioxys angelicae* Haliday, which constituted almost 50% of all the obtained parasitoids of grade I (Fig. 1). It reduced the population of aphid *Aphis pomi* De Geer on the shrubs of *C. divaricatus* as well as aphids *A. pomi* and *Dysaphis* Börn. on *C.* x *media.* The second place as regards the number was taken by the species *Pauesia picta* Haliday**,** whose percent constituted 18.18%. It was found on the shrubs *P. mugo*, where it reduced the number of aphid *Cinara pini* L. *Aphidius ervi* Haliday was also characterised by relatively high population. Its host aphids were *Macrosiphum rosae* (L) and *Metopolophilium dirhodum* (Walk.) preying on roses

Tab. 1. Number and terms of flights of parasitoids reared from aphids mummies

Parasitoids (family, species)	Species of host aphids	Species of host plants	Number in specimens						Total	Percentage contribu-tion (%)	Terms of flights (month)
			1999		2000		2001				
			A	B	A	B	A	B			
Aphidiidae											
Aphidiinae											
Aphidius rosae Haliday	*Macrosiphum rosae* (L.), *Chaetosiphon tetrarhodus* (Walk.)	*Rosa* sp.	2		5		4	5	16	8.08	V-VIII
	Macrosiphum rosae (L.), *Metopolophium dirhodum* (Walk.)	*Rosa* sp.	1	1	4	2	6	2			
Aphidius ervi Haliday	*Cinara juniperi* (De Geer)	*Juniperus communis* L.				1	7	3	27	13.64	IV-VIII
	Aphis pomi De Geer, *Dysaphis* Börn.	*Crataegus* x *media* Bechst.	2	1	39	1	2				
Trioxys angelicae Haliday	*Aphis pomi* De Geer	*Cotoneaster divaricatus* Rehd. Et Wil.		1	5	10	21	16	98	49.49	IV-VIII
Pauesia picta Haliday	*Cinara pini* L.	*Pinus mugo* Turra			27	1	6	2	36	18.18	V-XI
	Macrosiphum rosae (L.), *Metopolophium dirhodum* (Walk.)	*Rosa* sp.				1		1			
	Aphis pomi De Geer	*Cotoneaster divaricatus* Rehd. Et Wil.					2	2			
Ephedrinae											
Ephedrus plagiator Nees	*Aphis pomi* De Geer	*Crataegus* x *media* Bechst.					7	6	19	9.60	V-VII
Prainae	*Macrosiphum rosae* (L.)	*Rosa* sp.					1				
Praon volucre Haliday		*Cotoneaster divaricatus*									
Praon sp.	*Aphis pomi* De Geer	Rehd. Et Wil.			1				2	1.01	V-VII

and *Cinara juniperi* (De Geer) occurring on the shrubs of common juniper. The proportion of the other species belonging to this family: *Aphidius rosae* Haliday, *Aphidius ervi* Haliday, *Ephedrus plagiator* Ness, *Praon volucre* Haliday, *Praon* sp. was small and it did not exceed 10% totally. The host aphids for *Aphidius rosae* were aphids *M. rosae* and *Chaetosiphon tetrarhodus* (Walk.) colonising the rose shrubs. The population of aphids *M. rosae* was also limited by *Ephedrus plagiator* Nees from the sub-family *Ephedrinae* and *Praon volucre* Haliday and *Praon* sp. from the sub-family *Prainae.* Besides, *Ephedrus plagiator* parasitized aphids *M. dirhodum* on roses while *A. pomi* on cotoneaster and hawthorn. *A. pomi* preying on the shrubs of *C. divaricatus* was the host for two species of parasitic Hymenoptera from the sub-family *Prainae.* Parasitoids were most frequently observed between May and August.

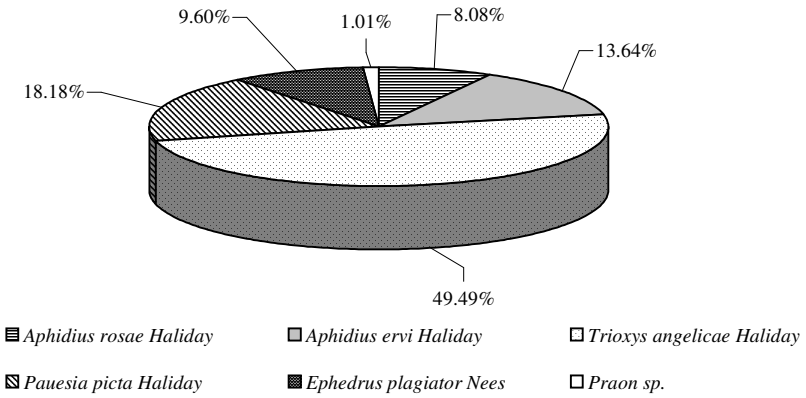

Fig. 1. Percentage contribution of particular parasitoids species reared from aphids mummies

The most species of parasitoids from the family *Aphidiidae* (4 species) were obtained from aphids *M. rosae* preying on roses, while the fewest (one species from each) from aphids *Ch. tetrarhodus* on roses, *Dysaphis* on hawthorn, *C. juniperi* on common juniper and *Cinara pini* L. on mountain pine.

The number of *Aphidiidae* was affected by the presence of hyperparasitoids. Their rearing gave 216 specimens, which constituted 52% of all the Hymenoptera. They belonged to five families: *Cynipidae*, *Pteromalidae*, *Encyrtidae*, *Eulophidae* and *Megaspilidae* (Tab. 2). The dominating species were *Charips victrix* Westwood and *Pachyneuron aphidis* Bouché. They were observed on all five shrub species: *Rosa* sp., *J. communis*, *C.* x *media*, *C. divaricatus* and *P. mugo*. Their proportion among all hyperparasitoids constituted 31.94% and 28.70%, respectively (Fig. 2). Relatively numerous populations were characteristic of two other ectohyperparasitoids, namely *Dendrocerus carpenteri* Curtis (14.81%) and *Asaphes vulgaris* Walker (11.11%). The presence of *Dendrocerus carpenteri* was observed on all five species of shrubs, while *Asaphes vulgaris*

Tab. 2. Number and terms of flights of hiperparasitoids

Hiperparasitoids (family, species)	Species of host aphids	Species of host plants	Number in specimens						Total	Percentage contribution (%)	Terms of flights (month)
			1999		2000		2001				
			A	B	A	B	A	B			
Cynipoidae	*Macrosiphum rosae* (L.)	*Rosa* sp.			20	25	1				
Cynipidae	*Aphis pomi* De Geer	*Crataegus* x *media* Bechst.			3						
Charpinae	*Aphis pomi* De Geer	*Cotoneaster divaricatus* Rehd. et Wil.	1			6	3	3	69	31.94	V-VIII
Charips victrix Westwood	*Cinara juniperi* (De Geer)	*Juniperus communis* L.	1			2	1				
	Cinara pini L.	*Pinus mugo* Turra			2		1				
Chalcidoidea	*Macrosiphum rosae* (L.)	*Rosa* sp.			11	21					
Pteromalidae	*Aphis pomi* De Geer	*Crataegus* x *media* Bechst.	1				2				
Pteromalinae	*Aphis pomi* De Geer	*Cotoneaster divaricatus* Rehd. et Wil.				17			62	28.70	V-VII
Pachyneuron aphidis Bouché	*Cinara pini* L.	*Pinus mugo* Turra	10								
Coruna clavata Walker	*Macrosiphum rosae* (L.)	*Rosa* sp.		1		2					
	Cinara pini L.	*Pinus mugo* Turra			1	1		1	12	5.56	IV-XI
	Cinara juniperi (De Geer)	*Juniperus communis* L.	2				3	1			
Asaphinae	*Macrosiphum rosae* (L.)	*Rosa* sp.			1	1					
Asaphes vulgaris Walker	*Cinara pini* L.,	*Pinus mugo* Turra			5						
	Aphis pomi De Geer,	*Crataegus* x *media* Bechst.		1			5		24	11.11	V-X
	Cinara juniperi (De Geer)	*Juniperus communis* L.		1	2		8				
Encyrtidae											
Encyrtinae	***Aphis pomi* De Geer**	*Cotoneaster divaricatus* Rehd. et Wil.				6			9	4.17	V-VII
Aphidencyrtus ephidivorus Mayr	*Aphis pomi* De Geer	*Crataegus* x *media* Bechst.					3				
Leptomastidea bifasciata Mayr	*Cinara juniperi* (De Geer)	*Juniperus communis* L.					1		1	0.47	VI
Eulophidae											
Tetrastichinae											
Tetrastichus sp.	***Macrosiphum rosae*** (L.)	*Rosa* sp.					7		7	3.24	VI
Megaspilidae	*Macrosiphum rosae* (L.)	*Rosa* sp.			6	17					
Megaspilinae	*Aphis pomi* De Geer	*Crataegus* x *media* Bechst.			1		3				
Dendrocerus carpenteri Curtis	*Aphis pomi* De Geer	*Cotoneaster divaricatus* Rehd. et Wil.	1			2			32	14.81	V-VIII
	Cinara pini L.	*Pinus mugo* Turra			1						
	Cinara juniperi (De Geer)	*Juniperus communis* L.					1				

on four: *Rosa* sp., *J. communis*, *C.* x *media* and *P. mugo*. The proportion of the other four species (*Coruna clavata* Walker, *Aphidencyrtus ephidivorus* Mayr, *Leptomastidea bifasciata* Mayr, *Tetrastichus* sp.) of hyperparasitoids ranged from 0.47% to 5.56%. The longest period of occurrence was characteristic of the species *Coruna clavata*, whose flights were observed from April till September, and *Asaphes vulgaris*, whose presence was observed between May and October.

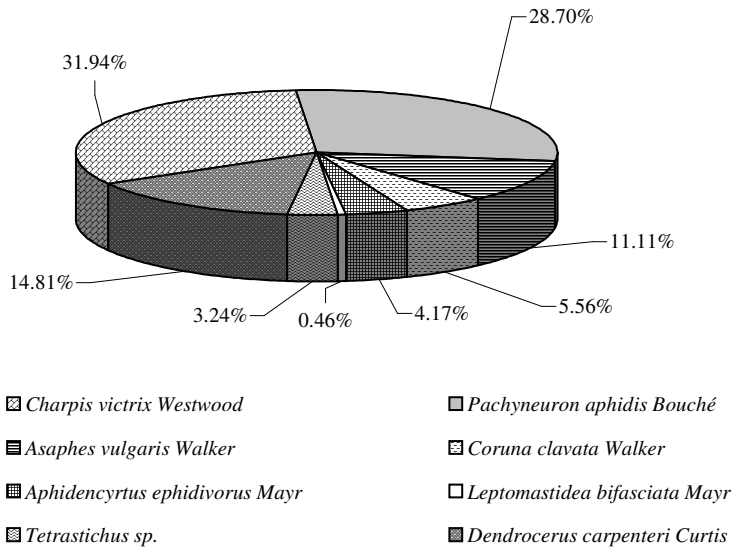

Fig. 2. Percentage contribution of particular hiperparasitoids species reared from aphids mummies

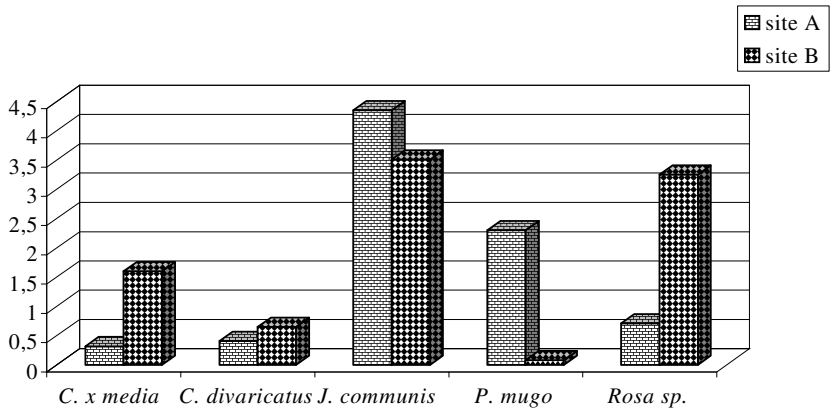

Fig. 3. Percentage contribution of parasitised aphids in site A and B

It was found out that the reduction of aphid population colonising the examined shrubs by parasitic Hymenoptera was low and it ranged from 0.08% to 4.35%, depending on the plant and the site (Fig. 3). The highest percentage of parasitized aphids in site A was observed on the shrubs of common juniper and the lowest on hawthorn. In site B parasitoids limited the aphid population most effectively also on common juniper, and the least effectively on mountain pine.

DISCUSSION

The presence of parasitic Hymenoptera of grades I and II was observed on five shrub species: *Rosa* sp., *Juniperus communis* L., *Crataegus* x *media* Bechst., *Cotoneaster divaricatus* Rehder et E.H. Wilson and *Pinus mugo* Turra. Parasitoids constituted 48%, while hyperparasitoids 52% of all Hymenoptera. Pankanin-Franczyk and Sobota (1998) found out in their studies that the percentage proportion of parasitoids was considerably lower than of hyperparasitoids and it constituted 30% and 70%, respectively.

In the Lublin area the greatest number of parasititized aphids was observed on common juniper (over 4%), and the smallest on mountain pine (less than 0.1%). All the reared parasitoids belonged to the family of *Aphidiidae*. Similar results were obtained by other authors (Werstak and Wiąckowski, 1998, Wiąckowski *et al*., 1997), who studied the parasitic entomofauna of aphids in urban agglomerations and determined the species composition of aphid parasitoids on decorative plants. On the other hand, Barczak (1998) reports that species belonging both to *Aphidiidae* and *Aphelinidae* families occur in the complex of primary parasitoids accompanying aphids on various plants.

The present studies marked 6 species among the parasitoids of grade I on 5 species of decorative shrubs, which 4 attacked aphids on roses, 3 on cotoneaster, 2 on hawthorn and 1 on pine. Wiąckowski *et al*. (1997) obtained 19 species of parasitoids from 26 species of various decorative plants.

The highest number of *Aphidiidae* species was reared from aphids *M. rosae* (4 species) and similar results were obtained by Wiąckowski *et al*. (1997).

The parasitoid of the greatest number was *Trioxys angelicae* Haliday, whose percentage proportion among all *Aphidiidae* reached more than 23%. It accompanied aphids *Aphis pomi* De Geer and *Dysaphis* Börn. on hawthorn, and aphid *A. pomi* on cotoneaster. Barczak (1998), Barczak *et al*. (1999) and Cierniewska (1976) report high effectiveness of *Trioxys angelicae* in controlling different species of aphids.

Hyperparasitoids constituted 52% of all parasitic Hymenoptera. They limited more than half of the parasitoid number in aphid mummies. Holler *et al.* (1993) report that hyperparasitoids can limit the population of aphid parasitoids on cereals almost in 100%, especially at the end of the vegetation period.

In the author's own studies hyperparasitoids were included into 5 families: *Cynipidae*, *Pteromalidae*, *Encyrtidae*, *Eulophidae* and *Megaspilidae*. The most numerous were the species of *Charips victrix* Westwood and *Pachyneuron aphidis* Bouché, which totally constituted 31% of all reared hyperparasitoids. Barczak (1994) also writes about the domination of Hymenoptera from the species of *Pachyneuron aphidis* in the colonies of aphids *Aphis fabae* Scop. on European spindle-tree. Pankanin-Franczyk and Sobota (1998), on the other hand, report that the hyperparasitoid that dominated in the colonies of aphids preying on cereals was *Dendrocerus carpenteri* Curtis. In the present studies this species occupied the third position in respect of its number (14.81%).

Parasitization of aphids on all the studied shrubs was low and it ranged from 0.08% to 4.35%, depending on the plant and the site. It was found out that the reduction of aphid population on cereals can be much higher and reach from 15% (Kaf and Miczulski 1991) to more than 30% (Holler *et al*. 1993). The greatest degree of parasitization is observed 7–10 days after the maximum population of aphids (Al Dobai and Praslicka 1999).

CONCLUSIONS

1. The rearing of parasitized aphids provided parasitic Hymenoptera (*Hymenoptera*: *Parasitica*) of grades I and II.

2. Parasitoids constituted 48% and hyperparasitoids 52% of all Hymenoptera obtained from the mummies.

3. The most numerous parasitoid was *Trioxys angelicae* Haliday, whose proportion among the parasitic Hymenoptera of grade I was almost 50%.

4. *Charips victrix* Westwood was the most numerous species among hyperparasitoids.

5. Aphid parasitization on the examined shrubs was low and it ranged from 0.08% to 4.35%.

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STRESZCZENIE

Obserwacje prowadzono w latach 1999-2001 na krzewach *Rosa* sp., *Juniperus communis* L., *Juniperus* x *pfitzeriana* (L. Späth) P.A. Schmidt, *Crataegus* x *media* Bechst., *Cotoneaster divaricatus* Rehder et E.H. Wilson, *Pinus mugo* Turra, *Cornus alba* L., *Spiraea japonica* L.f. w warunkach miejskich Lublina. Celem badań było ustalenie składu gatunkowego oraz liczebności pasożytniczych błonkówek (*Hymenoptera*: *Parasitica*) towarzyszących mszycom. Uzyskane dorosłe osobniki *Hymenoptera* zaliczono do parazytoidów I (48%) i II (52%) stopnia. Pasożytnicze błonkówki I stopnia należały wyłącznie do rodziny *Aphidiidae*. Wśród nich najliczniejszym gatunkiem był *Trioxys angelicae* Haliday. Hiperparazytoidy zaliczono do pięciu rodzin (*Cynipidae*, *Pteromalidae*, *Encyrtidae*, *Eulophidae* i *Megaspilidae*), a gatunkami dominującymi były *Charips victrix* Westwood i *Pachyneuron aphidis* Bouché. Spasożytowanie mszyc na badanych krzewach było niewielkie i wahało się od 0,08 do 4,35%.